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ABSTRACT

Over a 10-week period, an elementary school teacher designed and implemented a practicum study intended to help a target group of 24 kindergartners develop crucial mathematical problem-solving skills and to prepare them for taking the Stanford Achievement Test. The objective was addressed through implementation of direct instruction, modeling, role playing, manipulatives, and cooperative grouping strategies. It was expected that students would acquire the ability to listen and respond to simple oral directions and oral mathematical story problems, complete simple patterns, write addition and subtraction number sentences for story problems, and interpret and solve simple addition and subtraction application problems. A mastery criterion of 80 percent was set for each objective. Practicum evaluation data indicated that the criterion was not met on any of the objectives. It was concluded that students demonstrated positive attitudes toward mathematics application activities at the end of the study. Appendices provide sample surveys, an analysis of student progress, pre- and post-test results, and sample activity sheets. (RH)

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DEVELOPING PROBLEM SOLVING SKILLS IN KINDERGARTEN THROUGH SELECTED STRATEGIES

by

Maria Llovet

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A Practicum Report
Submitted to the Faculty of the Center for the Advancement of Education at Nova University in partial fulfillment of the requirements for the degree of Master of Science.

July 1990

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Abstract

Developing Problem Solving Skills in Kindergarten Through Selected Strategies.
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Descriptors: Mathematics Skills/Mathematical Enrichment/Mathematical Applications/Word Problems/ Elementary School Mathematics/Early Childhood Mathematics/Mathematics Instruction/Teaching Methods/ Kindergarten/Problem Solving/Creative Thinking/Critical Thinking/

The writer researched and implemented a program to help a target group of twenty-four kindergarten students develop crucial mathematical problem solving skills. The study focused on orally presented story problems. The objectives included the ability to complete simple patterns, interpret, write number sentences, and solve simple addition and subtraction application type problems. The strategies included direct teacher instruction and modeling, role playing, manipulatives, and cooperative grouping. The goal of this study was to introduce, instruct, and provide mathematical application strategies to develop students' problem solving abilities. A pre/post test was administered to demonstrate the need for the study and document the growth and level of achievemert as a result of this program. Quizzes were administered weekly to monitor progress and assure student understanding of the specific objectives. It was also concluded that students demonstrated positive attitudes toward mathematics application at the end of this study. The appendices include sample surveys, analysis of student progress, pre/post test results, and sample activity sheets.

Authorship Statement

I hereby testify that this paper and the work it reports are entirely my own. Where it has been necessary to draw from the work of others, published or unpublished, I have acknowledged such work in accordance with accepted scholarly and editorial practice. I give this testimony freely, out of respect for the scholarship of other workers in the field and in the hope that my own work, presented here, will earn similar respect.

Signed Maria Llovet

Maria Llovet

Appendix J

Nova University
Center For The Advancement of Education
3301 College Avenue
Fort Lauderdale, FL 33314

Observer Verification Form

Verification of Practicum Activity

Dear Observer:

Practicum students in Nova's M.S. and Ed.S. programs are asked to provide external verification that the project activities reported in their final practicum documents took place as described. You have been designated an observer to fulfill this confirmation function by the student named below. On this sheet, then, please write a note attesting to your knowledge of the project activity described in the final practicum report to which this will be attached. (Note that you are not asked to evaluate or make judgments about the quality of the project.)

Practicum Title Developing Problem Solving Skills in Kindergarten Through Selected Strategies

Student's Name Maria Llovet

Program Site Jane S. Roberts Elem. School Date July 25, 1990

Observer's Name Denise J. Travis Denise J. Travis
(please print---------and sign)

Observer's position Department Chairperson Phone # 220-8254/WK 559-1627 Hm

Observer's comment on impact of the project (handwritten):

The program was well planned and implemented by Maria Llovet. The kindergarten students gained important knowledge and skills in the area of problem solving. The strategies and activities were excellent.

Table of Contents

Page

Title Page i

Abstract ii

Authorship Statement iii

Observer's Verification iv

Table of Contents v

List of Tables vii

Chapters

I. Purpose 1

II. Research and Solution Strategy 8

III. Method 17

IV. Results 26

V. Recommendations 30

Reference List 32

Appendices

Appendix A: Primary Teacher Questionnaire . . . 34

Appendix B: Primary Teacher Questionnaire Results 36

Appendix C: Secondary Teacher Questionnaire . . 37

Appendix D: Secondary Teacher Questionnaire Results 39

Appendix E: Administrator Questionnaire 40

Page

Appendix F: Pre/Post-Test 41

Appendix G: Following Directions Quiz 43

Appendix H: Pattern Worksheet 44

Appendix I: Quiz: Simple Patterns 45

Appendix J: Problem Solving Strategies 46

Appendix K: Problem Solving Process 47

Appendix L: Mid-Course Inventory 48

Appendix M: Story Pictures 50

Appendix N: Quiz: Write a Number Sentence for each Story 51

Appendix O: Quiz: Write the Number Sentence for each Story 52

Appendix P: Quiz: Write the Number Sentence for each Story 53

Appendix Q: Quiz: Write a Number Sentence and Solve 54

Appendix R: Quiz: Write the Number Sentence and Answer 56

Appendix S: Quiz: Write the Number Sentence and Answer 57

Appendix T: Pre/Post-Test Results 58

Appendix U: Weekly Quiz Results 59

Appendix V: Teacher Observation Checklist . . . 60

Appendix W: Student Attitude Survey 61

Appendix X: Student Attitude Survey Results . . 62

List of Tables

Page

Tables

Table 1: Pre/Post-Test 27

CHAPTER I

Purpose

A suburban middle socio-economic neighborhood was the setting for this study. This community presented a picture of constant growth. Construction projects filled the area. The homes in this region ranged from grandiose mansion homes to moderate town homes and condominiums. The population in this community was unstable. This transient quality was due to the changes and growth in the area.

The elementary school in which the study was conducted, a relief school built to accommodate a booming suburb, was being housed in an over-crowded neighborhood school. The actual moving occurred in the third reporting period. The new building for the targeted school is of a modern architectural design consisting of self-contained classrooms. Each equipped with state of the art features.

The writer gathered background information from the parent school. The targeted school has not been in existence long enough to have sufficient information for the purpose of the study.

The targeted school serviced in-house programs for students in kindergarten through sixth grade. Such programs included: Bilingual Education, Learning Disabled, Exceptional Education, and Academic Excellence. Before and after school care was provided for the vast majority of students with working parents in this area.

The Parent Teacher Association was established with eager and overwhelming support. The members worked to raise funds to purchase educational activities and materials in order to enhance the school's curricula. The parent volunteer program, recently incorporated into the school's functioning body, provided assistance and support throughout the school.

The staff at the targeted school was composed of 22 primary teachers, 9 intermediate teachers, 9.5 special area teachers, 3 exceptional education teachers, 1 emotionally handicapped supplementary teacher, 1 varying exceptionalities teacher, 3 emotionally handicapped aides, 1 system aide, 1 media specialist, 2 administrators, 1 secretary, 2 clerks, and 1 custodian. The ethnic composition of the staff was as follows: 37 percent White Non-Hispanic, 28

percent Black Non-Hispanic, and 35 percent Hispanic teachers. The administration and other school personnel was integrated, thereby composing a heterogeneous staff.

The total school enrollment was 870 students. The student population was composed of 33 percent White Non-Hispanic, 3 percent Black Non-Hispanic, 61 percent Hispanic, and 3 percent Asian.

The primary goal of mathematics instruction is the development of the ability to solve problems presented in real life (Burton, 1985). Yet, analysis of the Stanford Achievement Test results for the targeted school for the 1988-89 school year revealed a negative performance in mathematics application for grades second, fifth, and sixth. Furthermore, district Stanford Achievement scores disclosed the same deficiency.

Even though mathematical application is not specifically tested and designated in grades kindergarten and first, problem solving skills are included in the general mathematics section of the Stanford Achievement Test. According to these scores for the 1988-89 school year, analysis revealed that

students in kindergarten and first grade scored slightly below the fiftieth median percentile.

In spite of the constant concern and new found importance, problem solving is extremely difficult for most students. "Quite often children have difficulty solving word problems, even if they have previously exhibited competence in mathematical computation" (Lapp and Flood, 1983:256). It was the intent of the writer to develop mathematical problem solving skills for students in kindergarten. Early instruction and intervention would bring forth later achievement.

In establishing a need for this practicum, colleagues completed a story problem questionnaire. The questionnaire addressed the reasons for the difficulty in solving story problems and the strategies used by the teacher to improve problem solving skills. Among the difficulties were poor reading comprehension, guessing, poor attitudes, and lack of self-confidence. Among the strategies used to improve problem solving were daily practice, directed teaching, cooperative grouping, manipulative, pictures, early and frequent instruction. The results highlighted a need for this study (Appendices A,B,C,D). Also, the administrators

were consulted on this issue (Appendix E). Their results also expressed a need for this study.

The students should attain at least 80 percent mastery on all inventories and classwork assignments involving mathematical problem solving for simple patterns and addition and subtraction story problems. Also, analysis of the Stanford Achievement test mathematics section for the 1989-90 school year should reveal above average median percentile, at least the 80th percentile mark for the target group. Presently the students who will participate in this study lack problem solving strategies and ability. The pretest scores reveal that only 4.2 percent of the 24 students achieved 80 percent mastery and that the remaining 85.8 percent scored in the fiftieth percentile mark or slightly below. The discrepancy is therefore 30 percent. It was thus the purpose of this study to introduce, instruct, and provide mathematical application strategies and activities to develop students' problem solving abilities.

The writer of this study was a White Hispanic, fourth year teacher with previous experience teaching kindergarten and pre-kindergarten in a low socio-economic, predominantly Hispanic community.

Presently teaching kindergarten in a self-contained setting, the writer was also the sponsor of the Future Educators of America Club.

The implementation of this study took place in a kindergarten class of twenty-four students. All the students participated for a period of ten weeks. The students were expected to complete the following:

1. Over a period of ten weeks, the students would listen and respond to simple oral directions and oral mathematical story problems with 80 percent mastery as measured by teacher made pre/post test.

2. Over a period of ten weeks, the students would complete simple patterns with 80 percent mastery as measured by a teacher made pre/post test.

3. Over a period of ten weeks, the students would write addition and subtraction number sentences for story problems with 80 percent mastery as measured by a teacher made pre/post test.

4. Over a period of ten weeks, the students would interpret and solve simple addition and subtraction application type problems with 80 percent mastery as measured by a teacher made pre/post test.

The implementation of this study prepared the students for the Stanford Achievement Test.

The intended purpose of this study was to provide early and frequent practice in the area of problem solving, since today's students need ample and varied opportunities to learn to apply mathematics in everyday situations. These skills were developed gradually, as students need to experience positive results and gain confidence to ensure learning and success. "If children are to become efficient problem-solvers, they must develop positive attitudes toward problem solving" (Kennedy, 1980:80). It was also the intended purpose of the writer to establish positive attitudes toward mathematical application and ensure continued growth in this area of the elementary school curriculum.

CHAPTER II

Research and Solution Strategy

A computer search was conducted and additional research was completed to determine strategies, difficulties, and approaches in the solution of various kinds of mathematical problems. "The results of the most recent national mathematics assessment reveal a drop in problem solving skills, thereby documenting a problem in our schools" (Wheatley and Wheatley, 1984:22). Talton's research findings (1987) indicated that students can perform straight computation, but have difficulty processing mathematical information found in problem solving.

According to the National Council of Teachers of Mathematics, present day focus for school arithmetic must be on problem solving (Campbell, 1984). Not only is problem solving ability critical to human progress, it is also one of the most important aspects of mathematics today. Furthermore, by illustrating the applications of mathematical ideas and relationships among object, problem solving enhances the learning of mathematical facts, concepts, principles, and skills (Castaneda, Gibb, and McDermitt, 1982).

Problem solving is defined as a:

> process . . . the means by which an individual uses previously acquired knowledge, skills, and understanding to satisfy the demands of an unfamiliar situation (Campbell, 1984:11).

Problem solving involves applications:

> when the learner must sort out information, define the problem, and choose the relevant mathematical skills and concepts that are needed to solve the problem (Underhill, 1981:57).

Succinctly stated, "problem solving requires the synthesis of many bits of information, the analysis of a situation, and the application of procedures" (Burton, 1985:211).

While attention is being focused on teaching problem solving in the intermediate grades, educators must not neglect early instruction and the feasibility that early intervention may curtail the present findings concerning problem solving. When problem solving is ignored in early instruction:

> the mathematics learned is likely to consist of memorization of number names, of the counting order of number names, and rote use of numbers and operation names, rather than conceptual learning (Castaneda, Gibb, and McDermitt, 1982:23).

In addition, early childhood is a crucial time to build a readiness for problem solving:

> Young children can profit from activities that encourage them to explore their environment mathematically and build a network of relationships that can form a basis for problem solving (Wheatley and Wheatley, (1984:32).

Soon after students are introduced to formal arithmetic, a confrontation with application type story problems occurs. Although it is commonly assumed that problem solving is difficult for students at all levels of the mathematics curriculum, young students are very good at solving simple word problems and their solutions are often creative and involve relatively sophisticated problem solving processes (Carpenter, 1985). Educators should take advantage of the young student's problem solving strategies and abilities. This approach is thus conducive to the development of an understanding of number concepts and their operations while fostering problem solving experiences.

Problem solving in the primary grades is achieved within a structured framework that allows each student to develop and gain confidence as he or she learns to apply new concepts. A pre-requisite is to "create an atmosphere conducive to exploration and learning" (Wheatley and Wheatley, 1984:22). The Mississippi State Department of Education, in a document developed to assist teachers increase the mathematical

competencies of young students, reported that "students need lots of practice in 'natural' motivating situations" (Talton, 1985:98). In addition, Castaneda, Gibb, and McDermitt (1984) identified several guidelines for selecting problem solving activities. These include:

1. Activities should not be verbally demanding, all required information should be within the problem.
2. Activities must be comprehensible to children and easily related to their world of reality.
3. A positive attitude toward problem solving is vital.
4. The problem situation should capture the interest of children because of the nature of the materials, the situation itself, and transformation that children can impose on the materials, or some combination of these factors.
5. When possible, select or design problems that may have different levels of solution.
6. Problem solving activities for young children need not require that children produce a written response.
7. Select problems that have applications of concepts in a variety of situations to aid in 'generalizing' a problem solving strategy (p. 28).

The method of study for analyzing word problems that seemed the most feasible for primary students is The Problem Solving Process (Shiotsu, 1989). The steps are as follows: Identify the problem, Choose a strategy, Solve the Problem, Check the answer.

The simultaneous development of concept and skill is crucial in the primary grades. These are achieved

in the classroom by providing vast and varied experiences that stimulate thinking (Wheatley and Wheatley, 1984). The Bureau of School Improvement in the Mississippi State Department of Education (1985) declared that concept development enhanced thinking ability and reinforced the relationship of numbers and their operation, while skills in mathematics serve to provide practice and the maintenance of basic facts. Skill and concept development is achieved when meaning, prior knowledge, and scope and sequence is incorporated into daily instruction.

Students' ability to solve problems develop through four general stages (Carpenter, 1985). At the earliest levels, instruction should be based on direct teacher modeling and problems that can be represented with physical objects. Students in kindergarten "can engage in significant problem solving through a wide variety of activities involving physical materials" (Van de Walle, 1988:62). This use of concrete materials facilitate experimentation without symbolic or written expression.

> Problem solving with manipulative (concrete) materials is a natural mode through which young children can build foundations for concepts later to be communicated through the use of mathematical symbols (Cantaneda, Gibb, McDermitt, 1982:23).

In addition:

> A problem with no manipulatives is, as expected the most difficult for young children to understand. An oral problem with concurrent physical movement of objects to depict the action in the problem generally prompts the greatest number of correct responses (Campbell, 1984:12).

Carpenter's next stage suggest that students begin to use pictorial representations and more readily visualize the necessary operation. This level requires proper understanding and comprehension. Comprehension may be indicated by the student's ability to paraphrase the problem. All that is required at this stage is that "children be able to translate the problem into their own words" (Campbell, 1984:12). To facilitate comprehension, students should be encouraged to act out the events in the problem or participate in the activity by being an active member of the audience (Campbell, 1984).

In stage three Carpenter found students relying primarily on counting strategies. At this level the student is able to symbolize the problem described by writing a number sentence and solving it. An activity to aid symbolization may require students to invent a situation to accompany the symbols found in an abstract number sentence (Campbell, 1984). Having students write

a number sentence for a picture is also effective (Campbell, 1984). Burns (1988) presented information which may help educators clarify, confirm, and check students' thinking and understanding. The article discussed the importance of evaluating students' reponses. This approach helps students go beyond the right answer. Thus, at this stage, symbolization is enhanced when students are required to verbalize and explain their response.

> By spending just a little time talking to a child about his or her solution to a problem, a teacher can gain a great deal of insight about the child's knowledge of mathematics and problem solving strategies (Carpenter, 1985:424).

In the final stage, students rely primarily on number facts. Evidence suggests that students reach this level in the second grade (Carpenter, 1985).

According to the research studies conducted by Talton (1987), students learn arithmetic without understanding how to apply it when solving word problems. To remedy this situation Talton developed TAPS--A Thinking Approach To Problem Solving, "a decision making model that will assist students to decide on the choice of operation in routine mathematical word problems" (Talton, 1987:1).

Initial, direct, teacher-led introduction of a process must be highly motivational and must engage the learners in verbal exchanges to assure clarity and precision of thought. This process will also help students develop the language skills necessary to solve mathematical problems (Campbell, 1984). Instruction should continue long enough and contain enough repetition to assure that students acquire control of the knowledge which they then are to exhibit during the processing of mathematical information (Talton, 1987).

Talton (1987) determined that movement from the concrete to the pictorial, and finally to the abstract must be well planned and followed during instruction. In addition, "care must be taken to associate mathematics language with real objects to which numerical expressions apply" (Talton, 1987:8).

The important features of this TAPS procedure include:

> teacher modeling, manipulation and discussion of problem elements, identification of the number groups and the choices of action, understanding the assumed movement, action or changes, and comprehending the question (Talton, 1987:18).

The TAPS model for problem solving in kindergarten:

THINK:
Display groups using concrete models.
Manipulate objects and discuss groups involved.
Analyze situations presented.
Determine action(s).
Consider the question asked.
DECIDE:
Combine two or more groups by adding.
Separate one group by subtraction.
Compare two or more groups to find the difference.
WRITE the number sentence.
SOLVE the number sentence.
CHECK the number sentence (Talton, 1987:22).

The basic strategy used by Rosenbaum, Behounek, Brown, and Burcalow (1989) included cooperative grouping.

> Cooperative grouping can give pupils an opportunity to practice problem solving skills in a low risk environment, while focusing on oral language skills (Rosenbaum, 1989:8).

Direct teacher modeling should be followed by cooperative group practices. TRICKS for successful cooperative groups include:

Teach strategies
Rehearse techniques
Involve everyone
Cooperate to solve problems
Keep groups small
Share ideas (Rosenbaum, 1989:11).

CHAPTER III

Method

During the ten weeks of implementation, the twenty-four kindergarten students who participated in the study were exposed to several different strategies according to the information collected for developing problem solving skills.

Direct teacher instruction and modeling were provided to the total group, small group, and individual. Individual instruction was provided according to the students' needs and to remediate deficiencies determined by weekly inventories.

The activities involved a multi-media approach. Student-centered activities were the focus of classroom instruction. Worksheets, developed commercially by many educational companies or designed by the writer for the purpose of this project, were minimally utilized. The sole purpose of the worksheets was to accustom the students to solve mathematical application type problems using paper and pencil in preparation for future inventories and the Stanford Achievement Test.

Supplementary materials were available in a special mathematics activity center. The center included self-correcting activity cards, simple addition and subtraction flash cards, additional practice worksheets, and hands-on thinking activities with corresponding manipulative materials. The students were encouraged to visit the center after completing classwork assignments. Activities at the center were varied and replaced weekly.

Since problem solving is part of the total mathematics program, the strategies and activities were incorporated into the regular mathematics kindergarten curriculum. The program was implemented three times per week for forty minutes. The rest of the mathematics instruction time was devoted to the enhancement of number concepts and computation skills in correspondence with the school adopted kindergarten textbook.

Tasks included during the ten week implementation period are described in the following timeline. Assessment was made weekly to ensure student understanding, mastery, or deficiencies so that adjustments could be implemented during the practicum process. A mid-course inventory was also administered.

Timeline of Tasks:

Prior to Week One: Tasks

1. Research conducted to determine need for study
2. Conferred with colleagues and administrators
3. Gathered and organized information and materials for the project
4. Composed lesson plan for the first week

Week One: Tasks

1. Administered pre-test (Appendix F)
2. Established activity center
3. Developed students' listening skills and ability to follow oral directions. Students were required to complete tasks presented orally. To check comprehension the students were asked to paraphrase oral directions given by the writer.
4. The students worked in pairs and took turns giving and following directions.
5. The students listened and moved to tape--following directions (We All Live Together, Vol. 2).

Week Two: Tasks

1. Completed quiz to determine if students could successfully follow oral directions (Appendix G). Played Follow the Leader after quiz.

2. To develop thinking skills, the writer reviewed patterns on the board using colored shapes to demonstrate repetition.
3. The students worked in groups of four and used attribute pieces to construct simple patterns.
4. The students completed worksheet to determine the pattern (Appendix H).

Week Three: Tasks

1. Quiz to determine if students could successfully complete simple patterns (Appendix I).
2. Introduced specific problem solving strategies (Appendix J) and encouraged them to develop original problem solving strategies.
3. Introduced and modeled the Problem Solving Process (Appendix K).
4. Practiced counting strategies and exercises and supplied the students with working manipulatives.

Week Four: Tasks

1. Orally checked students' understanding of the Problem Solving Process and the problem solving strategies (+,-).
2. The writer presented an addition or subtraction oral story problem. Repeated and asked the students to role play. Discussed what took

place. Continued with this procedure until the students became familiar with the concept of "putting together" and "taking away."

3. Repeated the oral story problems previously presented and used manipulatives to demonstrate the action that is required to solve the problems.
4. The students worked in pairs to create their own application type problem which they modeled for the class. The class participated by discussing the action and possible solution.

Week Five: Tasks

1. Administered mid-course inventory (Appendix L).
2. The writer repeated some of the story problems previously presented and used flannel board pieces to demonstrate and review the operation. At this time the writer elicited student responses to introduce number sentences.
3. The students worked in pairs, established in week four, and wrote a number sentence to match their originally created story problem. The writer circulated among the groups and checked understanding.
4. The students continued to symbolize story problems by writing a number sentence to correspond with a

picture. Discussed the pictures and all the possible number sentences that may be created (Appendix M).

Week Six: Tasks

1. Quiz to determine if students could successfully write number sentences for orally presented story problems (Appendix N).
2. Once conceptualization of the problem had been developed, the students continued to practice, using manipulatives, with the story problems presented in week four and five.
3. The students worked in pairs to create a story problem to go with a number sentence, previously written on a flash card by the writer. The students used manipulatives to role play their story problem and asked the class to write a number sentence they thought represented the story. Responses were checked immediately.

Week Seven: Tasks

1. Quiz to determine if students could successfully write number sentences for orally presented story problems (Appendix O).
2. The students began to solve the orally presented problems in week four and five. The students were

encouraged to use manipulatives or counting strategies to find the solution.

3. The students wrote number sentences and solved orally presented story problems (Appendix P).

Week Eight: Tasks

1. Quiz to determine if students could successfully write number sentences and solve orally presented story problems (Appendix Q).
2. Each student was given two index cards with an operation on each card (+,-). The activity required the writer to orally present a story problem, each student would hold up an index card to indicate the operation needed to solve the problem.
3. The students solved story problems. After each problem the writer would stop and ask each student to verbally explain the answer. Continued until all students had the opportunity to express their thinking and reasoning.

Week Nine: Tasks

1. Quiz to determine if students could successfully write number sentences and solve orally presented story problems (Appendix R).

2. Teacher made game which consisted of matching the correct number sentence to the story problem. The students were divided into groups of four. Each group received two sets of index cards--one set contained addition and subtraction word problems and matching picture to illustrate, and another set contained number sentences. Since the desks were arranged in groups of four the students were able to put all the cards face up on the table and take turns interpreting and matching word problems to the correct number sentence to solve the problem. The letter behind the card with the story problem must match the letter behind the number sentence card. If the cards matched, the student kept the cards. When all the cards were gone, the student(s) with the most cards won the game.
3. For additional practice the students interpreted, wrote a number sentence and solved a story problem. The story problems were individually taped. The students would then solve the problems by listening to their peers. The story problems were discussed, analyzed, and solved as a whole group.

Week Ten: Tasks

1. Created simple story book of at least three picture story problems. Traded with peers. Each student then wrote a number sentence and solved the problems. Demonstrated several examples to the whole class and encouraged participation.
2. Reviewed orally presented story problems in preparation for post-test (Appendix S).
3. Administered post-test (Appendix F).
4. Administered Student Attitude Survey (Appendix W).

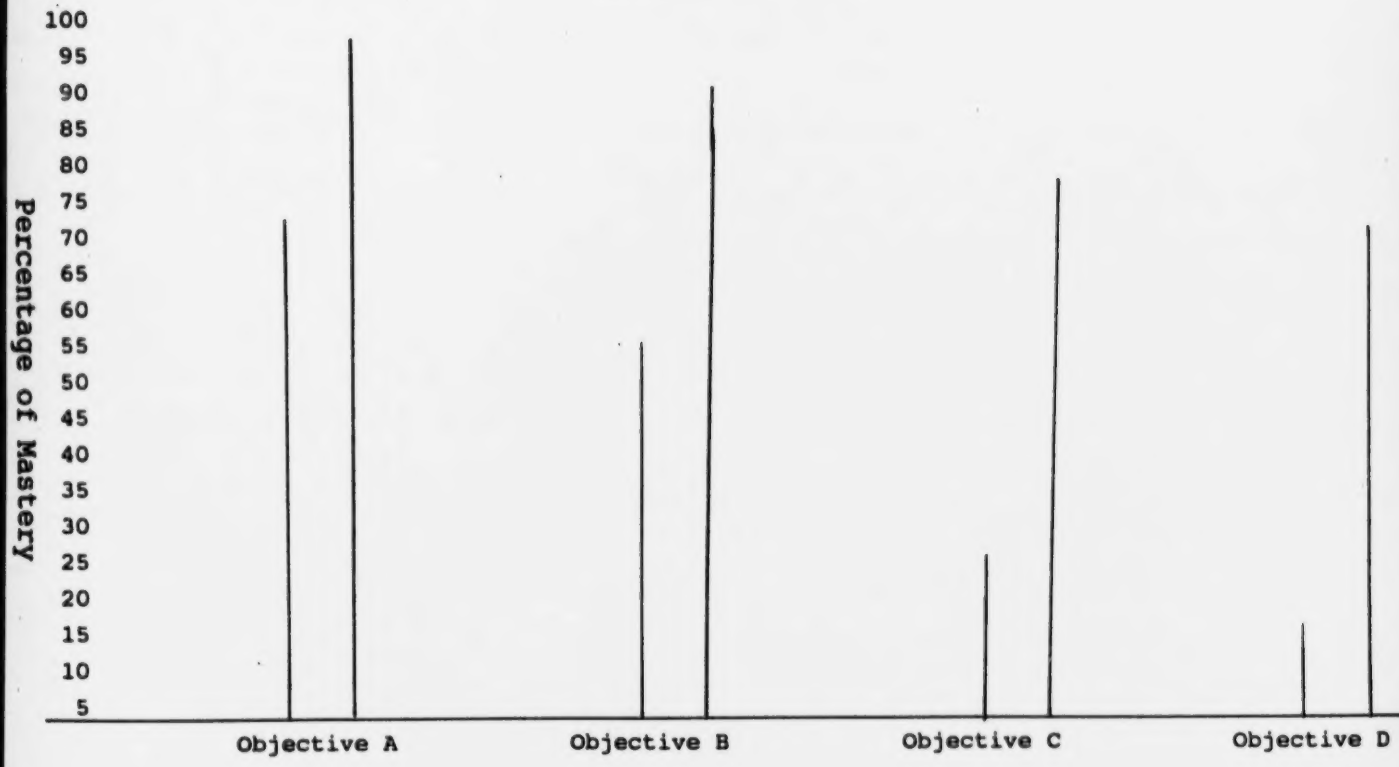
CHAPTER IV

Results

Achievement of the targeted kindergarten students was measured by comparing the pre/post-test results (Appendix T). The pre/post-test included and measured the mastery of four kindergarten problem solving objectives (Table 1). The first objective was the ability to listen and respond to simple oral directions. This objective was represented by four items on the test, each worth four points. The second objective, represented by three items on the test and each worth four points, required the students to complete simple patterns. The third objective was to interpret orally presented story problems and write addition and subtraction number sentences. The fourth objective required the students to solve the problems. The third and fourth objectives were represented on the pre/post-test by eight items each worth ten points, five points for interpretation and five points for correct solutions. The last two items on the test, each worth six points, asked the students to draw a picture to illustrate the printed number sentence.

TABLE 1

Pre-Test / Post-Test



In addition to the pre/post-test, weekly inventories were administered during implementation. These weekly quizzes demonstrated step by step progress of each of the stated objectives (Appendix U). Adjustments and/or additions were considered as a result of students' weekly performance. Student reactions were also noted. A teacher observation checklist (Appendix V) was employed to determine student needs.

A student attitude survey (Appendix W) was also conducted at the end of the study to assess problem solving attitudes and determine implications for future math application instruction and learning. The results revealed positive attitudes toward problem solving (Appendix X).

Teacher directed activities helped students focus on the process of problem solving, identification of key words, and the solution of word problems using the appropriate number sentence. The students analyzed how addition problems differ from subtraction, which assisted in the solution of these word problems when they were mixed in the quiz. Pictures and manipulatives were excellent resources that promoted student understanding of the problem solving concepts. It made

the solution of the problem clear in the students' mind.

The small group games encouraged the students to be active participants, therefore, the students were enthusiastic since they did not have to wait a long time for their turn. According to the teacher observation checklist the students were on task and excited about the activities. Students appeared to work well together and assisted each other. Students enjoyed the activities and eagerly participated and engaged themselves in the problem solving strategies. The students' attitudes were positive in the learning process. Therefore, as students got involved in the learning process, student achievement increased.

CHAPTER V

Recommendation

Although the program provides a strong basis for the introduction of strategies and activities to promote good problem solvers, the process must be an on going part of the total math program for the succeeding grades. Furthermore, problem solving skills can be taught in all academic areas, and when taught in context with other subject areas, will become meaningful and relevant to the students' education. This is a goal which needs to be explored by those who develop curricula. A problem solving mathematics program with clearly detailed objectives which is logical and sequential and with appropriate student centered activities must be developed.

The wrier would like to expand the use of this practicum project in the target school. Total kindergarten involvement will significantly improve problem solving skills presently and in the future. The writer made copies of the practicum project to be used by other kindergarten teachers and explained the importance of the program, the positive results, and

the activities. Also, total school involvement focusing on problem solving skills and critical thinking in mathematics should be encouraged. Excerpts of the study were duplicated and distributed at a faculty meeting. At this time, the writer explained and discussed the importance of the program, the student-centered activities, and the results. Colleagues were encouraged to enhance problem solving skills using the strategies implemented in this practicum report. A copy of the practicum was placed in the media center to share with colleagues.

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APPENDICES

APPENDIX A

Primary Teacher Questionnaire

Appendix A

Primary Teacher Questionnaire

Dear Teachers:

I am doing some research for my practicum proposal concerning the need to teach problem solving skills in kindergarten. Your cooperation in providing the information below will be greatly appreciated.

Thank you,

Maria Llovet

1. Is there a need for teaching problem solving skills in kindergarten?

   Yes_____ No_____

2. In your professional opinion, do you feel kindergarten students are ready to be introduced to problem solving skills and mathematical application?

   Yes_____ No_____

3. Do you teach problem solving skills and mathematical application?

   Yes_____ No_____

4. What strategies have you used with your students that you found to be effective?

   _____

   _____

   _____

5. If you have noticed that students have difficulty with math application, what do you feel are the underlying reasons for this difficulty?

_____

_____

_____

Appendix B

Primary Teacher Questionnaire Results

A total of twenty primary teachers responded.

1. Yes 18 No 2

2. Yes 18 No 2

3. Yes 8 No 12

4. The eight teachers responded with manipulatives and practice worksheets.

5. Thirteen teachers responded lack of understanding and not enough practice.

Appendix C

Secondary Teacher Questionnaire

Dear Teachers:

I am doing some research for my practicum proposal concerning the need to teach problem solving skills in kindergarten. Your cooperation in providing the information below will be greatly appreciated.

Thank you,

Maria Llovet

1. Is there a need for teaching problem solving skills in kindergarten?

   Yes _____ No _____

2. Do you feel that students would benefit from early instruction in problem solving and mathematical application? Why? Why not?

   _____

   _____

   _____

3. If you have noticed that students have difficulty with math application, what do you feel are the underlying reasons for this difficulty?

   _____

   _____

   _____

4. What strategies have you used that you found to be effective with your students.

_____

_____

_____

APPENDIX D

Secondary Teacher Questionnaire Results

A total of eight secondary teachers responded.

1. Yes 7 No 1

2. All of the teachers expressed a need because early instruction would facilitate later understanding and success.

3. All of the teachers indicated that students had difficulty with math application because students do not know what operation to use, lack of practice, and negative attitudes.

4. All of the teachers indicated that effective strategies include cooperative grouping, manipulatives, and positive experience.

APPENDIX E

Administrator Questionnaire

1. Is there a need for teaching problem solving and mathematical skills in kindergarten? Why? Why not?

_____

_____

_____

2. Do you feel that kindergarten students are ready to be introduced to problem solving and mathematical application? Please explain.

_____

_____

_____

3. Do you feel that early instruction may reduce the fear and difficulty associated with problem solving and mathematical application? Why? Why not?

_____

_____

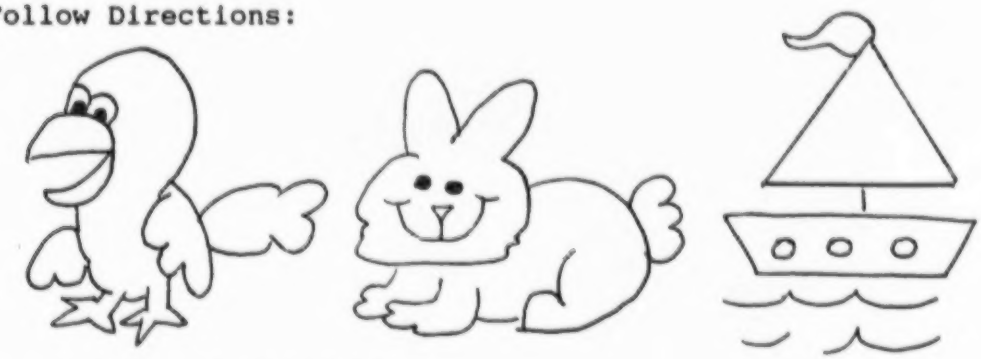
_____

APPENDIX F

Pre/Post-Test

Name:_____ Date_____

Follow Directions:



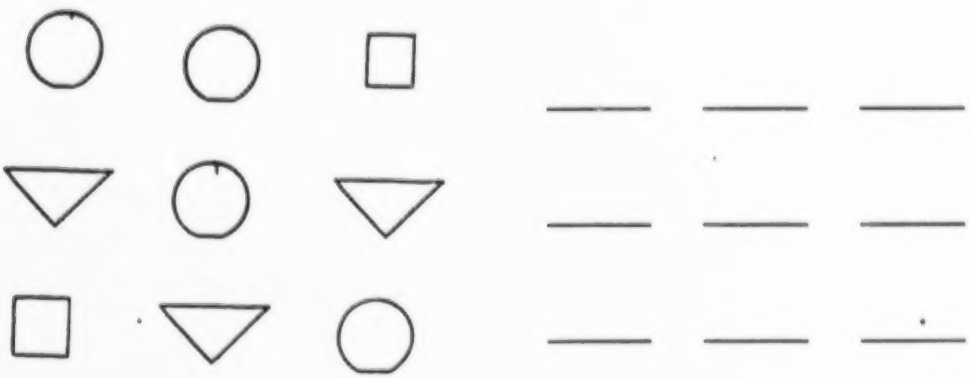
( ) Color the bird blue

( ) Color the bunny brown with pink ears

( ) Color the boat yellow with a red sail

( ) Put a yellow sun over the boat

Complete the pattern:



Write a number sentence and solve:

Seven fish are in the water.
One more fish comes.
How many in all? ___ ___ ___ = ___

Six balloons are in the room.
Two fly away.
How many are left? ___ ___ ___ = ___

Bill has ten stickers.
He gives away three.
How many stickers does he have left? ___ ___ ___ = ___

Three frogs are in a pond.
Six more frogs come.
How many frogs in all? ___ ___ ___ = ___

Five cars are parked.
Two drive away.
How many cars are left? ___ ___ ___ = ___

Four birds sitting in a tree.
Four birds fly away.
How many birds are left? ___ ___ ___ = ___

Draw a picture to match the number sentences.

4 + 3 = 7

9 - 2 = 7

APPENDIX G

Following Directions Quiz

( ) Make two black birds up in the sky

( ) Draw some green grass

( ) Give Mr. Dog a tall black hat

( ) Put three red dots on his tie

( ) Make a little purple bug in the grass

( ) Draw a small tree

( ) Put two red apples in the tree

( ) Color Mr. Dog brown

( ) Draw a pink and blue butterfly in the air

( ) Put five different colored balloons in Mr. Dog's hand

APPENDIX H

Pattern Worksheet

1.

2.

3.

4.

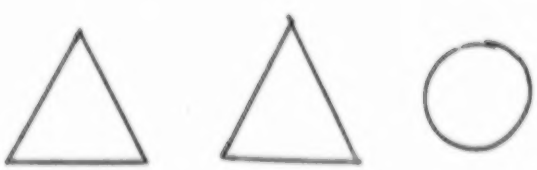
APPENDIX I

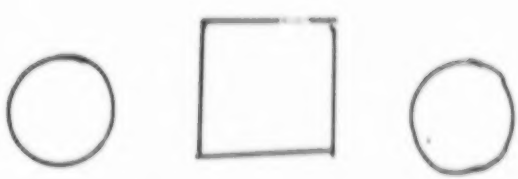
Quiz: Simple Patterns

Draw what shape comes next:

1. _____

2. _____

3.  _____

4.  _____

APPENDIX J

Problem Solving Strategies

For solving story problems in the primary grades use these Problem Solving Strategies:

model the problem

act out the problem

guess and check the solution

make a list of the given

look for a pattern

To assist students develop these strategies emphasize counting activities and exercises, supply the students with manipulatives, and encourage the students to develop their own problem solving strategies.

(Wheatley and Wheatley, 1984)

APPENDIX K

Problem Solving Process

Teach the students important problem solving strategies and the following problem solving process to help them become confident problem solvers. This process, broken down into four steps, will help students solve problems effectively.

1. Identify the problem
   This requires students to read or listen to the problem, state in their own words what is is being asked, and find the information they need to solve it.

2. Choose a strategy
   This means that students must decide what to do.

3. Solve the problem
   Once a strategy is chosen, students carry it out. This step often requires computation.

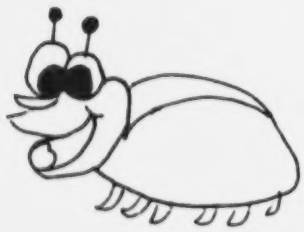
4. Check the answer
   Students should always be encouraged to check their work. Answers should be reasonable and make sense.

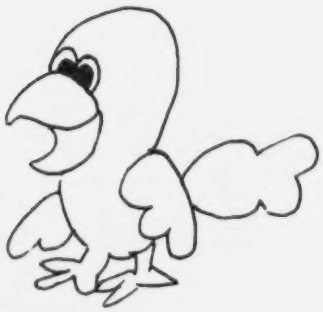
(Shiotsu, 1989)

APPENDIX L

Mid-Course Inventory

Follow directions:





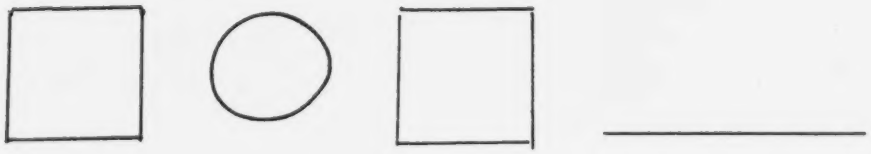
(1) Put four green dots on the bug

(2) Color the bug orange

(3) Give the bird an orange tail, bill, and legs

(4) Color the bird yellow

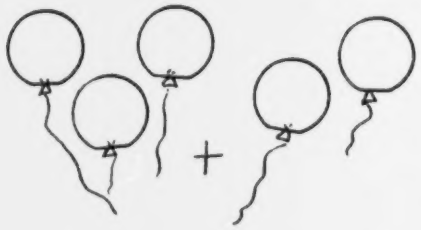
Complete the pattern:

(5) 

(6)

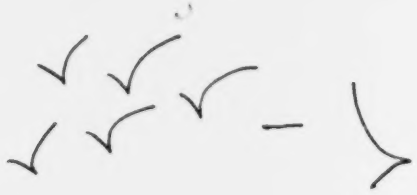
(7) Draw a picture to illustrate a story problem

(8) Circle the correct action demonstrated in the picture



(a) putting together (b) taking away

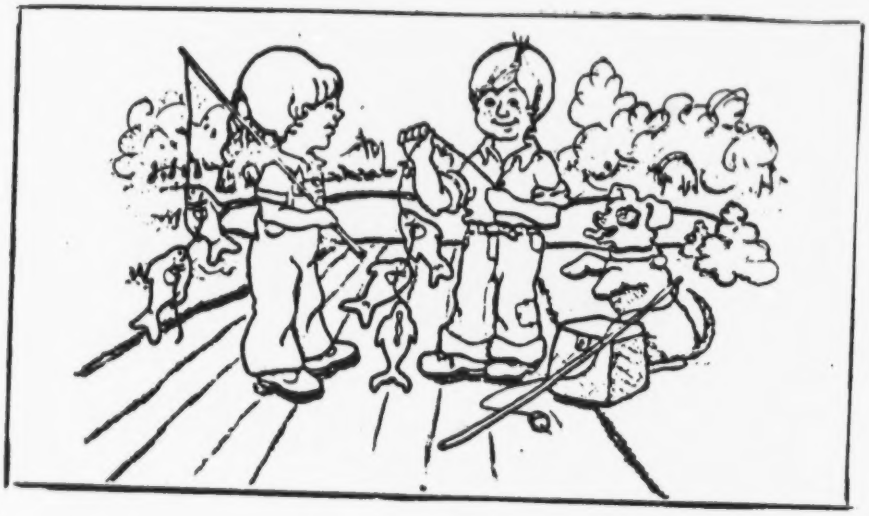
(9) Circle the correct action demonstrated in the picture



(a) putting together (b) taking away

APPENDIX M

Story Pictures



APPENDIX N

Quiz: Write a number sentence for each story

1. Alexia has two candy bars.
   Frankie gives her one more candy bar.
   How many candy bars does Alexia have now?

2. Five frogs are resting in a pond.
   Two frogs hop away.
   How many frogs are left in the pond?

3. Steven has six pencils.
   He gives Jonathan two pencils.
   How many pencils does Steven have left?

4. Vanessa has eight stickers.
   The teacher gives her two more stickers.
   How many stickers does Vanessa have altogether?

5. Four ants are marching down the park.
   One ant stops to rest.
   How many ants are left walking?

APPENDIX O

Quiz: Write the Number Sentence for each story

1. Two flowers are in a vase.
   Three flowers are in a pot.
   How many flowers altogether?

2. Three fish are in a bowl.
   Four fish are in a tank.
   How many fish are there in all?

3. Michael has six balls.
   Two balls are red.
   How many balls are blue.

4. Ana has five apples.
   Natalie has three apples.
   How many apples do they have in all?

5. Anthony has seven balloons.
   Three balloons flew away.
   How many balloons are left?

Quiz: Write the number sentence and answer

APPENDIX P

Quiz: Write the Number Sentence for each story

1. Ten birds.
   Two flew away.
   How many birds left?

2. Four cats.
   Two more.
   One more.
   How many cats in all?

3. Two rabbits.
   Seven more.
   How many rabbits all together?

4. Eight frogs.
   Three got away.
   How many frogs now?

5. Nine dogs.
   Two ran away.
   How many dogs left?

6. Seven goldfish.
   One more.
   How many goldfish all together?

APPENDIX Q

Quiz: Write a number sentence and solve

1. Six birds are sitting in a nest.
   Two birds fly away.
   How many birds are left in the nest?

2. Four ducks are swimming in a pond.
   Three ducks come to join them.
   How many ducks are in the pond now?

3. Three chickens are in the hen house.
   The farmer puts five more chickens in the hen house.
   How many chickens are in the hen house altogether?

4. Five monkeys are playing in a tree.
   Two monkeys go home.
   How many monkeys are left?

5. Seven fish are in the lake.
   Three more fish come.
   How many fish in all are in the lake?

6. Eight rockets are waiting to take off.
   Three of the rockets take off.
   How many rockets are left on the ground?

7. Five girls are at the park.
   Two boys join them.
   How many children are at the park altogether?

8. One horse is at the circus.
   Four more horses come.
   How many horses altogether?

9. Ana has three ice cream cones.
She gives away two of them.
How many ice cream cones does Ana have left?

10. Candace bought ten cupcakes.
We ate eight of them.
How many cupcakes are left?

APPENDIX R

Quiz: Write the number sentence and answer

1. Three shoes
   Two were put away.
   How many shoes are left?

2. Seven sandals.
   Three were lost.
   How many sandals are there now?

3. Five slippers.
   One more.
   Two more.
   How many slippers in all?

4. Two sneakers.
   One more.
   How many sneakers all together?

5. Nine boots.
   Four were sold.
   How many boots left?

6. Two skates.
   Eight more.
   How many skates are there now?

APPENDIX S

Quiz: Write the number sentence and answer

1. Three snails.
   Two more came.
   How many snails in all?

2. Six butterflies.
   One flew away.
   How many butterflies left.

3. Five worms.
   Three more now.
   How many worms all together?

4. Seven bees.
   Seven flew away.
   How many bees now?

5. Eight grasshoppers.
   Seven jumped away.
   How many grasshoppers are left.

6. Four ants.
   Five more.
   How many ants now?

APPENDIX T

Pre/Post-Test Results

Students	Pre-test Scores Percentage	Post-test Scores Percentage	Gain
1	45	90	45
2	64	100	36
3	20	84	64
4	16	92	76
5	24	84	60
6	54	96	42
7	8	82	74
8	16	80	64
9	8	74	66
10	8	76	68
11	16	84	68
12	54	100	46
13	0	74	74
14	46	89	43
15	12	90	78
16	20	94	74
17	12	92	80
18	0	74	74
19	39	86	47
20	12	80	68
21	84	100	16
22	20	86	66
23	8	80	72
24	12	84	70
	Total = 598	Total = 2069	
	Mean = 24.9	Mean = 86.2	
	Range = 84	Range = 26	
	Mode = 8	Mode = 84	

APPENDIX U

Weekly Quiz Results

Student	Pre-test Week 1	Week 2	Week 3	Week 4	Interim Week 5	Week 6	Week 7	Week 8	Week 9	Post-test Week 10
1	45	80	100	+	100	80	100	80	100	90
2	64	100	100	+	90	60	80	70	80	100
3	20	80	100	+	100	60	80	90	100	84
4	16	70	100	+	90	80	100	90	100	92
5	24	90	100	+	90	60	80	80	80	84
6	54	100	100	+	100	60	80	70	80	96
7	8	70	100	+	100	80	100	80	100	82
8	16	80	100	+	80	60	60	70	80	80
9	8	70	75	+	80	80	100	80	90	74
10	8	80	100	+	100	60	80	70	80	76
11	16	80	100	+	100	80	100	80	100	84
12	54	100	100	+	90	80	100	90	100	100
13	0	70	75	-	80	60	80	70	90	74
14	46	80	100	+	80	60	80	60	80	89
15	12	70	100	+	100	80	100	70	90	90
16	20	80	100	+	90	60	80	80	100	94
17	12	80	100	+	100	60	80	70	80	92
18	0	70	75	-	80	40	60	60	80	74
19	39	80	100	+	100	80	100	80	100	86
20	12	70	75	+	80	40	60	70	80	80
21	84	100	100	+	90	100	100	90	100	100
22	20	90	100	+	90	80	100	80	100	86
23	8	80	100	+	100	40	60	60	80	80
24	12	80	100	+	90	60	80	70	90	84
Students achieving 80% mastery	4.2%	70.9%	83.3%	91.7%	100%	41.7%	83.3%	50%	100%	89.9%

APPENDIX V

Teacher Observation Checklist

1. _____ Student(s) are involved in the activity.

2. _____ Student(s) are frustrated by the activity.

   Names of students_____

   _____

3. _____ Student(s) are working well together.

4. _____ Student(s) are complaining to others.

   Names of student(s)_____

   _____

5. _____ Student(s) are following directions.

6. _____ Teacher must explain directions while activity is in progress.

   Names of student(s)_____

   _____

7. _____ Teacher must assist with clarification of word problems.

   Names of students(s) _____

   _____

8. _____ Student(s) appear to enjoy the activity.

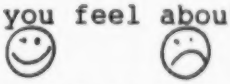
Today's Date_____

APPENDIX W

Student Attitude Survey

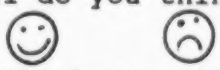
Listen carefully to the question and bubble in the
to indicate how you feel.

1. How do you feel about math class?

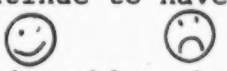


2. How do you feel when you are given a word problem to do?

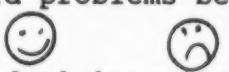
3. How well do you think you can solve word problems?



4. Do you think you will do better on word problems if you continue to have more practice?



5. Can word problems be fun to solve?



6. Do you feel learning to solve story problems is important?

APPENDIX X

Student Attitude Survey Results

1.		24		0
2.		23		1
3.		23		1
4.		24		0
5.		24		0
6.		20		4

APPENDIX X

Student Attitude Survey Results

1.		24		0
2.		23		1
3.		23		1
4.		24		0
5.		24		0
6.		20		4